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Automobile Emission Inspection and Maintenance: Issues and Options

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by

Steven Colome
Graduate School of Public Health
Harvard University

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Part I

Introduction and Summary Chart of Options

This review is designed to outline the rationale and the design options available to Massachusetts for a program of Inspection and Maintenance for motor vehicle emission systems. Those desiring a short introduction to the subject can review the summary chart on page 2 and read the six-page question-and-answer section which follows. If more depth is required, the remaining text and separately bound extensive appendices are suggested.

Over the past 10 years, Massachusetts has had considerable success in reducing air pollutants from power plants, factories, and other stationary sources. Air pollutants from automobiles, however, have become worse. In order to reduce the impact of this serious public health problem, the Clean Air Act Amendments of 1970 require the EPA to establish "primary" air quality standards. Section 110 of the Act also requires that each state adopt a plan which provides for the attainment, maintenance and enforcement of such standards in each air quality control region within a state. As part of such a plan, each state should provide to the extent necessary and practicable, for the periodic inspection and testing of motor vehicles to enforce compliance with applicable emission standards.

The basic state legislative decision involves the choice of an administrative and management structure for implementing the federally mandated requirements. It will be useful to carefully review the advantages and disadvantages of state, private contractor, and private garage systems.

SUMMARY CHART
Advantages and Disadvantages

Facility Operator	Advantages	Disadvantages
State	Consumer Protection: 1. Inspection separate from repair: no conflict of interest. 2. Independent basis for judging the performance of the service industry. 3. Monitoring of instruments and inspector performance facilitated, thereby reducing testing variability. Cost: 1. Lower (inspection) labor costs, thus generally lower recurring costs. 2. More efficient use of equipment. Information: 1. Data collection facilitated. 2. Loaded mode testing possible.	Consumer Convenience: 1. Fewer inspection facilities, thus an increased probability of longer travel and wait times. Cost: 1. Start-up requires large public capital outlay. 2. All program costs borne by public sector. 3. Risk of increasing long-term, fixed costs to government due to increase in number of potential retirement pension beneficiaries.
Private: Separate Emission Inspection Facilities	Consumer Protection: Same as State Operated Information: Cost: Same as state operated, plus 1. All program costs borne by private sector except those associated with state administration. 2. No risks of increasing long-term fixed government costs. 3. Permits use of corporate tax depreciation allowance to reduce burden of start-up capital expenditures.	Consumer Convenience: Same as state operated. Consumer Protection: 1. Possible adverse public reaction to corporation earning profits from "captive market."
Private: At Service Stations as part of regular automobile inspection	Consumer Convenience: 1. Greater number of facilities minimizes average travel and wait times. 2. Possibility for one-stop inspection maintenance. Cost: 1. Lower start-up costs. 2. All program costs borne by private sector except those associated with state administration.	Consumer Protection: 1. Inspection not separate from repairs presents potential for conflict of interest. 2. No independent basis for judging performance of service industry. 3. Effective monitoring of inspectors and instruments is more difficult. Cost: 1. Generally higher labor costs thus higher recurring costs. 2. Less efficient use of equipment. 3. Inspector training involves greater numbers and is therefore more costly. Information: 1. Uniform and detented data collection is more difficult. 2. Loaded mode tasting is improbable if not impossible.

Questions and Answers on Inspection and Maintenance

1. Q. What is an AUTOMOBILE INSPECTION AND MAINTENANCE PROGRAM?

   A. An Automobile Inspection and Maintenance Program provides for the periodic determination of whether an automobile's pollution control equipment is properly functioning and whether vehicle owners have had necessary repairs performed. Emission control equipment can function improperly or wear out with age and use just as a car's brakes, lights, and exhaust systems. Automobile owners are often unaware that their emission control equipment is no longer functioning, which is one of the reasons why sophisticated equipment and regular inspections are necessary to keep emission control devices properly operating.

   A statewide system of Inspection and Maintenance, with mandatory correction of emission system problems, will substantially reduce concentrations of the automobile-caused air pollutants in Massachusetts. In addition, a properly designed program should save car owners money by reducing the inefficient gasoline use which goes hand-in-hand with high tailpipe emissions.

2. Q. Why is a STATE INSPECTION AND MAINTENANCE PROGRAM REQUIRED?

   A. Section 110(a)(2)(G) of the Federal Clean Air Act Amendments of 1970 requires that states include in their air quality implementation plans, to the extent necessary and practicable, provisions for the periodic inspection and testing of motor vehicles to enforce compliance with applicable emission standards.

Additionally, Chapter 52.1140 of Vol. 40 No. 112 of the Federal Register of June 12, 1975 required the Commonwealth of Massachusetts to establish an Inspection and Maintenance program applicable to all gasoline powered light and medium duty vehicles in the Boston Intrastate Region and by no later than August 1, 1976 commence such inspections by a periodic idle-mode test.

3. Q. WHY DID THE FEDERAL GOVERNMENT DEVELOP THIS REQUIREMENT?

   A. The principal reason for requiring inspection and maintenance was to reduce the serious detrimental health effects which are caused directly by automobile exhaust.

4. Q. WHAT ARE THE EXHAUST POLLUTANTS WHICH AFFECT HEALTH, AND HOW WILL INSPECTION AND MAINTENANCE HELP REDUCE THEIR IMPACT?

A. Inspection and Maintenance programs are designed to reduce the level of two serious automobile caused pollutants: carbon monoxide and photochemical oxidants.

Carbon monoxide, which is colorless, odorless, tasteless, and potentially deadly, comes directly from the tailpipe in high concentrations that quickly disperse into the environment. Carbon monoxide from sources which are further away than about a mile away is at such a low concentration that it is not a problem. Locally produced carbon monoxide, however, can be of tremendous concern. Carbon monoxide is a serious problem when released into a closed congested place such as a garage, street corner, or town square.

The situation with photochemical oxidants is more complicated. Oxidants, as such, are not included in automobile exhaust. Rather, two pollutants which do come directly from the tailpipe, hydrocarbons and oxides of nitrogen, combine, through complex chemical reactions in the sunny atmosphere, to yield photochemical oxidants.

Because strong sunlight is important to the reactions, high concentrations of photochemical oxidants occur in Massachusetts only during the six months from May through October. However, since this pollutant is a serious problem even at low concentrations, it is a year-round, region-wide problem. Successful control of this pervasive pollutant will require control in all sections of Massachusetts as well as neighboring states.

Emission control devices result in a decrease of photochemical oxidants by reducing one essential ingredient: the tailpipe emissions of hydrocarbons. Through an effective inspection and maintenance program, the remaining oxides of nitrogen in the atmosphere will have fewer hydrocarbons to react with, and, therefore, the production of photochemical oxidants will be reduced.

5. Q. WHAT ARE THE HEALTH EFFECTS OF CARBON MONOXIDE AND PHOTOCHEMICAL OXIDANTS?

   A. Carbon monoxide is a harmful gas that replaces oxygen in the blood. Very high concentrations of carbon monoxide cause death while lower concentrations, which are typical of

congested streets, will dull the senses and reduce coordination. Persons with heart and lung diseases have a special strain placed on their systems by carbon monoxide.

Photochemical oxidants are potent irritants to the tissues of the eyes, nose, and lungs. Photochemical oxidants have also been shown to impair physical performance, dull senses, aggravate asthma, and cause long-term damage to the heart. Many plants are more sensitive than humans to photochemical oxidants and expensive crop damage may result from exposure.

6. Q. HOW IS A CAR TESTED?

   A. The basic procedure involves measuring the tailpipe gases of an automobile and comparing the resulting values with exhaust standards established for that automobile's model year. The vehicle can be tested while in idle (idle mode) or under simulated driving conditions (loaded mode).

7. Q. HOW OFTEN SHOULD A CAR BE INSPECTED AND HOW LONG DOES THE TEST TAKE?

   A. An annual inspection is acceptable to improve both air quality and gasoline mileage. Testing could be staggered throughout the year to minimize testing bottlenecks and waiting time. The emission test takes less than one minute because the emission equipment responds instantly to the tailpipe gases. If safety inspection is combined with emission testing the entire procedure should take between 10 and 15 minutes.

8. Q. WHAT WILL BE THE COST OF AN INSPECTION?

A. An annual emission inspection, based on the experience of other states, should cost less than $5.00 per automobile. This figure includes any state administrative cost as well as the cost of operating the testing facilities. If the state safety inspection system is combined with emission testing the experience of other states indicates that the combined charge should be less than $10.00.

9. Q. IF A CAR FAILS INSPECTION, WHAT CAN MANDATORY REPAIRS BE EXPECTED TO COST?

A. Experience in states with emission inspection programs indicates that the majority of repairs are simple carburator adjustments or tune-ups. The average charge for mandatory repairs has been about $25.00. Since cars operate more efficiently following the typical emission system repairs, the value of the fuel saved in one year often exceeds the repair cost.

10. Q. WHO PERFORMS THE TEST AND WHAT TRAINING IS REQUIRED?

A. The test should be performed by an inspector trained in the operation of the delicate emission testing equipment. This inspector should also be trained to determine the accuracy of the testing equipment and make any necessary adjustments.

11. Q. WHERE WILL THE TESTS TAKE PLACE?

A. There appear to be, three basic options: (i) build specialized facilities operated by the state; (ii) build

specialized facilities operated by a private contractor; (iii) allow individual service stations to install equipment and conduct tests, most likely as part of existing inspection program.

If the program is conducted by the state or a private contractor, conveniently located testing facilities must be constructed. A network of 50 inspection stations would provide for an average travel distance of five miles and waiting time of less than five minutes. If the program is conducted by the private garages, testing could take place in any of the approximately 4,200 private garages which could purchase the necessary equipment and train their personnel.

12. Q. WHO MANUFACTURES THE EMISSION TESTING EQUIPMENT?

A. The equipment is manufactured and marketed nationally by several firms which specialize in instrumentation. Some Massachusetts companies compete actively in this market.

Part II

Supplemental Information

A. Why Inspection and Maintenance

1. The Federal Requirement

The Federal Motor Vehicle Control Program (FMVCP) was established by the Clean Air Act of 1970. This program requires a reduction in emissions (of 90% for 1978 for H.C. & Co. and 90% by 1979 for nitric oxides as compared with 1970 models) throughout their useful lives.

To insure that vehicles with emission control devices perform according to design capacity in reducing emissions, a program of Inspection and Maintenance is required. Through mandatory maintenance, an Inspection and Maintenance program can insure that automobiles are properly adjusted and can allow the Federal Motor Vehicle Control Program to make its maximum contribution to vehicle emissions reduction.

An Inspection and Maintenance program will also enhance the federal emissions control warrantee program authorized under Section 207(a) of the Clean Air Act. This provision requires the auto emissions equipment manufacturer bear the cost of repairs unless it can be shown that the vehicle has failed due to improper use or maintenance. This warranty would be good for five years or 50,000 miles on 1972 and later models. An Inspection and Maintenance program, by identifying

faulty emissions equipment, insures that the manufacturer, and not the vehicle owner, pays for the necessary repairs.

Along with enhancement of the warranty provisions, an Inspection and Maintenance program will be an incentive for vehicle owners to properly maintain their automobiles and for manufacturers to design durable and serviceable emission systems.

2. Protecting Public Health - Major Pollutants and Human Health

Cars and trucks are directly responsible for producing three major air pollutants. They are Hydrocarbons (HC), Carbon Monoxide (CO), and Nitric Oxides (NO_x). In addition, motor vehicles are indirectly responsible for photochemical oxidant pollutants which are formed by the interaction of hydrocarbons and nitric oxides in sunlight.

A motor vehicle Inspection and Maintenance program is designed to reduce the emission of hydrocarbons and carbon monoxide from the automobile tailpipe. The reduction in hydrocarbons will also reduce the chemical reactions involving NO_x that are responsible for the production of photochemical oxidants. The successful reduction of these pollutants through an Inspection and Maintenance program requires the identification and correction of automobiles which no longer perform according to their design specifications. Corrective maintenance of these defective automobiles should significantly improve air quality while increasing gasoline mileage and engine life.

The following is a more detailed description of the sources and distribution of the air pollutants which will be controlled by an Inspection and Maintenance program.

During the 1950's and 1960's there was growing concern about the effect of air pollutants on human health. Various pollutants were identified as causing or aggravating emphysema, asthma, bronchitis, heart disease, and cancer. In addition, farm crops and forests were damaged, buildings were visibly sooted and erroded, metals were corroded, and visibility was seriously reduced.

The available scientific evidence on health effects was gathered together into air quality "Criteria Documents" which were used to establish national standards for carbon monoxide, hydrocarbons, nitrogen oxides, photochemical oxidants, sulfur oxides, and particulates. The primary and secondary standards for these pollutants were established on April 30, 1971.

Primary standards are the least stringent and are designed to protect human health. Massachusetts is currently exceeding the primary health related standard for nitrogen oxides, photochemical oxidants, carbon monoxide, and particulates. The secondary standard, which has not been implemented, is more stringent than the primary standard and is designed to provide protection for the public welfare (e.g., crop and building damage) in addition to human health.

The standards as developed from the "Criteria Documents" have been reviewed several times since their establishment by the National Academy of Sciences. In its reviews, the Academy has continued to support the standards as originally established.

Additionally, new evidence presented to the Academy indicates that the detrimental health effects related to air pollutants may be more serious than was originally thought.

Persons suffering from asthma, emphysema, and heart and lung disease are particularly susceptible to the effects of air pollutants. Air pollution will accelerate the rate of disease in those afflicted with these diseases and they may be responsible for early death. In addition, air pollution may be responsible for helping to initiate disease in otherwise healthy persons.

People who do not have heart and lung disease and do not believe they feel the effects of air pollution nonetheless experience a reduction in fine coordination and lung function when exposed to certain air pollutants. Since many of these changes occur undetected, it is sometimes difficult to convince the public of the necessity for control.

Dramatic evidence for the benefits following improvement in air quality occurred during the 1974 fuel crisis. Because less gasoline was purchased and automobiles were driven less, air quality improved. The result of this improvement was a 10% decrease in the death rate for all causes (this significant improvement was observed even after the effect of reduced auto accident deaths, from lower speeds, was removed).

Improving human health and preventing disease remain the principal reasons for reducing air pollution. Automobile related pollutants significantly affect human health and their special effects are described in the following sections.

a. Carbon Monoxide (CO)

For all practical purposes, the automobile is the only important source of carbon monoxide (CO). Over 80% of the nationwide emissions of CO are produced by the incomplete combustion of gasoline in automobiles, according to data from the United States Environmental Protection Agency's 1973 National Emissions Data Bank.

An important factor in assessing carbon monoxide's potential for human health damage is understanding that it is a localized problem because it dissipates quickly to low concentrations which are not known to be harmful. For example, the carbon monoxide produced at Government Center will have little influence on the air quality at the State House on Beacon Hill. However, every town and square which attracts a large number of automobiles within a short period of time will have a CO problem.

The greatest exposure to carbon monoxide occurs while commuting in an automobile and to persons who work or live near street intersections and town squares where traffic congestion exists. A commuter traveling in the exhaust wake of many other automobiles, faces a cumulative effect that often results in high CO exposures. High carbon monoxide levels can also extend beyond the road and affect persons working and living in nearby buildings. These locations are referred to as carbon monoxide "hot spots" and they occur in many cities and towns. Apartment buildings above town squares and central businesses are particularly affected.

The carbon monoxide problem in Massachusetts is widespread: 80% of all monitoring sites have had violations in recent years.

Carbon monoxide (CO) is a colorless, odorless, and tasteless gas which is produced by incomplete combustion. High concentrations of this pollutant are frequently found in urban areas where the automobile is its main souce.

Carbon monoxide is harmful because it reduces the amount of oxygen which should reach the body's vital organs. CO combines 1000 times more readily with the red blood cell protein, hemoglobin, than does oxygen. When CO is inhaled into the lungs it attaches to hemoglobin producing carboxyhemoglobin and preventing the red blood cell from carrying a normal amount of oxygen.

At a sufficiently high concentration, oxygen will be denied to vital organs and death follows. CO concentrations in urban air do not reach this level but do go high enough to have a profound effect on health. At low concentrations, the presence of CO weakens heart contractions. This will cause a healthy person to have a reduced capacity for exercise but a person with existing heart disease is placed in risk of a heart attack when air concentrations of CO increase. Inhaling carbon monoxide not only increases the chance of a heart attack but also decreases the probability of survival following one.

At low concentrations, carbon monoxide can affect general mental function by reducing visual perception and mental alertness. Studies have shown that young automobile drivers exposed to CO react more slowly to situations requiring fast braking response. Common symptoms caused by CO include headaches, nausea, and drowsiness. Carbon monoxide is particularly harmful, though, to persons with heart, lung, cerebral vascular diseases, and anemia.

b. Hydrocarbons (HC)

The automobile contributes about half of the atmosphere's hydrocarbon pollution. The balance comes mostly from the evaporation of industrial solvents, gasoline production and distribution, and dry cleaning processes.

When hydrocarbons and nitrous oxides come together in sunlight, photochemical oxidant pollutants are formed. These oxidants can only be controlled by reducing the emission of either hydrocarbons or oxides of nitrogen.

Hydrocarbons and nitrous oxides emitted in out-of-state urban centers far away from Massachusetts may react in the atmosphere and be transported with the prevailing winds into this state. Additionally, other chemical substances may be carried into Massachusetts and react with locally produced hydrocarbons to produce harmful oxidants.

Hydrocarbon emissions now need to be reduced throughout Massachusetts to eliminate the statewide violations of the photochemical oxidant standard set by the EPA.

At the concentrations observed in the ambient air, no detrimental health effects are known to result from direct hydrocarbon pollution. However, the role of hydrocarbons in forming photochemical oxidants means that the hydrocarbons have a definite indirect effect on human health.

c. Photochemical Oxidants

Photochemical oxidants were first recognized in the 1940's in Los Angeles. For many years the chemistry of their formation eluded scientists. Even today the process is not fully understood, but we do know that photochemical oxidants are formed by hydrocarbons and nitrous oxides emitted from automobiles and that by reducing these emissions we are able to lower the concentration of the harmful photochemical oxidants.

Photochemical oxidant violations are observed in Massachusetts primarily between May and October when the sunlight required to drive the chemical reactions is strongest. Unlike carbon monoxide pollution, which is localized, photochemical oxidants can travel hundreds of miles. Because of our own emission problems and the transport of oxidants from out-of-state, violations of the federal standard are a problem throughout the entire Commonwealth. Every air monitoring site in Massachusetts has shown violations of the photochemical oxidant standard during the past few years. In fact, recordings have been made which are two and a half times the health related standard.

While it is possible to blame sources as far away as New York City for their contribution to the photochemical oxident problem in Massachusetts, our own sources may also contribute significantly to the Massachusetts photochemical oxidant problem and to violations in Vermont, New Hampshire, and Maine.

While photochemical oxidant pollutants are not emitted directly from the automobile tailpipe, they are produced in the atmosphere from hydrocarbons and oxides of nitrogen which are emitted directly by automobiles. The photochemical oxidants produced consist of ozone, formaldehyde, acrolein, peroxyacyl nitrate (PAN), nitrogen peroxide, and numerous other oxides.

Photochemical oxidants cause many detrimental health effects. Their greatest impact is on mucous membranes where severe irritation sometimes occurs to the eyes and respiratory system. Tears and eye inflammation are symptoms which occur at relatively low concentrations. At slightly higher concentrations, asthma patients find their conditions aggravated, and athletes and children at play have impaired performance and slowed reflexes. Studies have shown a correlation between automobile accidents and oxidant levels high enough to impair vision and dull senses.

Research in studies with animals has indicated that long-term damage to the heart and body may follow oxidant exposure. Laboratory animals exposed to oxidants exhibit

chronic bronchitis, emphysema, and increased risk of lung infections.

One of the major constituents of photochemical oxidants is ozone, which is a particularly potent irritant. Its effects on the respiratory system are accelerated by sulfur dioxide pollution which is higher in the Northeast than most of the nation. In addition, ozone can produce crop damage when it occurs at concentrations below that affecting human health.

3. Additional Program Benefits

In addition to complying with federal law and protecting public health, an Inspection and Maintenance program can produce the following additional benefits:

1. Decreased fuel consumption
2. Reduced costs due to emission equipment breakdowns
3. Increased automobile life
4. Early detection of engine wear
5. Early detection of potentially costly carburator malfunctions

B. Inspection and Maintenance Systems

1. The Technological Options

Currently available emission measurement equipment are described as either idle-mode or loaded-mode systems. There are several manufacturers of accurate systems for each mode.

Both idle mode and loaded mode emissions tests are fast and simple. In the idle mode, a probe is inserted into the tailpipe and a sample of exhaust gas is collected. This sample is instantly analyzed, and if the sample exceeds the allowable emissions for the particular vehicle, a red light goes on. These pass-fail results are known in less than one minute.

The loaded mode test is more comprehensive but takes only slightly longer. For this test, the automobile is driven onto a chassis dynomometer which allows simulated driving conditions at idle, and at 30 and 50 miles per hour. Test results are compared with the limits established for each operating condition. This test does not take much longer than one minute.

In addition to the idle and loaded tests, an emission inspection could involve a visual inspection for excessive smoke and an under-the-hood examination to detect tampering with the emissions system.

Since vehicle emissions have changed over the past years, different limits should be established for different years. For example, the following standards are currently in use in New Jersey:

Car Model Year	Carbon Monoxide (Percent)	Hydrocarbons (Parts per Million)
1967 and earlier	8.5	1,400
1968-1969	7.0	700
1970-1974	5.0	500
1975-1976	3.0	300

A car is considered to fail if its emissions of carbon monoxide or hydrocarbons exceeds the above limits.

2. Reasons for Emission Test Failure and Required Repairs

Emission system maintenance is often simple and inexpensive. Easy adjustments to high polluting automobile usually return them to their originally-designed, low-level emissions. The most likely sources of the problem are listed below:

Pollutant: Hydrocarbon

Likely Problem:
- Timing
- Ignition system malfunctions
- Improperly maintained pollution control equipment

Pollutant: Carbon Monoxide

Likely Problem:
- Carburator (fuel mixture)
- Dirty air cleaner
- Improperly maintained pollution control equipment

Expensive repairs, such as those that would be incurred in fixing of worn valves or piston rings, occur infrequently and are generally found in improperly maintained or grossly neglected automobiles. In order that the requirements of Inspection and Maintenance not exert an unnecessary and regressive burden on the owners of older automobiles, a dollar limit could be placed on repairs. This limit would allow a fair and cost-effective program which would provide the optimum emission reduction for every dollar invested in vehicle maintenance.

3. Consumer Costs for Testing and Repairs

Direct consumer costs for Inspection and Maintenance include the cost of the actual vehicle inspection and any required corrective maintenance. Regardless of the administrative structure for the Inspection and Maintenance program, the inspection of emissions alone should, based on experience in other states, be less than $5.00 per year for each automobile. As for repair costs, experience in other states indicates that the majority of repairs are simple and inexpensive. Costs that have been developed from three state programs are:

Arizona
January-February 1976

Repair Cost	Percentage of Repairs
Less than $5.00	27%
$5.00 - $10.00	17%
$10.00 - $25.00	24%
$25.00 - $50.00	20%
Over $100	10%
	100%

Oregon
January 1976

Repair Cost	Percentage of of Repairs
Less than $10	64%
$10.00 - $30.00	18%
$30.00 - $35.00	8%
$50.00 - $75.00	5%
$75.00 - $100.00	22%
	100%

New Jersey

Type of Repair	Cost of Repair	Percentage of Repairs
Sole Adjustment	Less than $10.00	46.4%
Minor Tune-Up	$13.00 - $40.00	33.7%
Major Tune-Up	$30.00 - $100.00	16.2%
Engine Overhaul	Over $100.00	3.7%
		100%

It costs over $2,000 per year in Massachusetts to operate the average automobile, including depreciation, gasoline, insurance and normal maintenance. Even if a vehicle fails an emissions inspection, the combined cost of inspection and maintenance can be expected to represent less than 1% of the annual operating expenses.

However, one of the more compelling reasons for recommending an Inspection and Maintenance program is the fuel economy benefits it will produce. If a tune-up is required to meet the Inspection and Maintenance standards, the vehicle owner will, on the average, according to the Environmental Protection Agency, produce an 8% fuel economy savings. Such an 8% fuel reduction would produce a $43 saving for a car which gets 13.5 mpg, travels 12,000, and uses gasoline costing 60¢ per gallon. This annual savings would more than compensate for the average cost of the tune-up.

More detailed and extensive data is available from the Olsen short cycle test which is reported in section 2.6.2.2 of "A review of control strategies for in-use vehicles" available from the EPA. The following table is derived from the Olsen data:

Emissions Test Failure Rate (Percent)	Overall Emissions Reduction (Percent)		Annual Fuel Savings for Serviced Automobiles (Percent)	Gallons of Gas Saved per Serviced Automobile	Dollars Saved per Serviced Automobile	Dollars Saved per Averaged Overall Tested Automobiles
	Carbon Monoxide	Hydro-Carbons				
10%	3%	6%	9.7%	82	$49.30	$ 4.90
20	6	8	6.8	57	14.40	6.85
30	8	10	5.5	47	28.00	8.40
40	9	11	4.7	40	24.00	9.60
50	10	11	4.2	36	21.40	10.70

From the above data it is clear that the fuel savings from inspection and maintenance is highly dependent on the vehicle failure rate established by the state. However, it should be noted that savings are realized for every failure rate and that the average savings for all tested cars increases with increasing failure rate (see last column).

Another issue which should be addressed in considering an Inspection and Maintenance program is the distinction between the direct out-of-pocket costs of inspection and repairs and the less-apparent fuel economy savings which largely or totally offset the direct costs.

Additional benefits for the vehicle owner include reduced breakdowns and prolonged engine life resulting from efficient operation of a clean-burning and frequently-maintained automobile.

Since most if not all of inspection and repair costs are offset by fuel savings, an Inspection and Maintenance program is one of the most cost-effective and least disruptive of the alternatives for reducing hydrocarbons and carbon monoxide.

4. State Costs for Capital Investment and Operation

A state-operated system will require major appropriations and the creation of a substantial new state administrative structure. The EPA estimates that the capital costs for each two-lane facility is needed for every 30,000 automobiles, this would mean a capital cost of between 14 and 40 million dollars for Massachusetts. Similarly, annual maintenance costs for

each two-lane facility are about $150,000 which would amount to an additional $16 million.

The costs to the state of operating an Inspection and Maintenance program are variable because they depend on the organizational structure chosen, size of staff, number of stations, and other options available in program design. Regardless of the organizational structure, however, experience in other states indicates that a charge to the vehicle owner of $5.00 or less should be able to fully cover the administrative and operational costs. This would be the case whether a program is operated by the state, a specialized private contractor, or independent service garages as part of regular safety inspections.

Depending on the organizational structure which is chosen, the fraction of the inspection fee going to the state would change. By using a private contractor operating specialized facilities, most of the administrative, data collection, and processing costs could be written into the contract. Using the approximately 5,000 garages, which are not under any central administration, would require a substantial state effort for enforcement, administration, and data processing. The exact costs would depend on the complete program design.

C. Legislative and Program Options

1. Program Administration

The basic decision regarding an Inspection and Maintenance program involves its administrative design. The three basic options for an Inspection and Maintenance organizational structure are:

i. state operation of specialized emission inspection stations

ii. private service garages with emission inspection equipment under state regulation

iii. private contractor operating specializing emission inspection stations but not performing repairs

Under any of the three administrative options is the capability to combine emissions testing with the existing vehicle safety inspection program.

This merger would mean that the vehicle owner would only make one stop for inspection. The safety inspection program could also be reviewed and upgraded at the time of the merger.

a. <u>State Operated System</u>

In this option, Massachusetts would acquire (rent or buy) land, equipment, and inspection stations, and operate the stations. There are several benefits of such a state-operated system: uniform training and testing procedures, systematic collection of data, and careful evaluations. Since the state would not be involved in making vehicle repairs, it would serve as an independent check on the quality of work performed by the repair industry.

For example, New Jersey operates its own system, and when its program was initiated, the vehicle owners were not required to, but could voluntarily, have their automobiles retested at a state facility after required repairs had been made at a private garage or dealership.

The fact that half of the vehicle owners decided to return voluntarily for a state retest is indicative of the public mistrust of the repair industry. In the Massachusetts Consumer Affairs Office, half of the complaints are reported to be automobile related and half of those pertain to vehicle repairs. Therefore, the independent check provided for by a state-run system can be considered a significant advantage.

b. Private Service Garages

Since private garages are currently used for the state's semi-annual safety inspection, the addition of emission inspection capability would require a relatively short start-up time and would involve lower initial costs. The large number of service stations which potentially could participate in this system would provide convenient access for most vehicle owners. Having the capability of testing and performing repairs in one location would be a convenience. But since inspection and repair are not separated, the potential for a conflict of interest exists. The garage could overcharge or perform unnecessary repairs, and the vehicle owner would not have available an independent check

on the garage. In addition, as is known to occur in the current safety inspection system, certain garages could develop reputations for leniency which would undo much of the potential benefit of having an Inspection and Maintenance program. The large number of facilities (nearly 5,000) would make data collection, training, standardization and government inspection difficult.

c. Private Contractor

In this option the state enters into a renewable agreement with a private company which is responsible for all the capital and operating expenses of the inspection facilities. Required repairs would still be made by the private garages and dealerships.

As with the state operated system, the benefits would include standardization, uniform training, data collection, and careful evaluation. Separation of the inspection and repair also eliminates the potential for conflicts of interest and prevents gouging of consumers in the repair market. By providing an independent check on the work of the private repair industry, a private inspection program could reduce repair costs and be an incentive for proper and careful repair.

But because of the reduced number of stations, waiting and travel times could be longer than experienced with a private garage system. This effect could be mitigated, as was the case in Arizona, by careful planning to determine station location and operating hours.

2. Experience from Other States

In comparing the various systems it would be useful to borrow from the experience of other states which have implemented Inspection and Maintenance programs. Unfortunately, all other situations are different from the one in Massachusetts and, therefore, only pieces can be gleaned from the experience of others. For example, New Jersey's state-operated system was added onto an existing state-run safety inspection system. Because the administrative, personnel, and capital structures were all in place, the cost of each added emission inspection is calculated at 34 cents (which includes the capital cost of the emission equipment and an appropriate fraction of the recurring annual expenses). There is no way, however, that Massachusetts could develop as inexpensive a system. But New Jersey's system was relatively overused and when emission inspections were added on, waiting times averaged a relatively long 15 minutes. Massachusetts could improve on this with a new system and a better design for station location.

Similarly, while Arizona has instituted an emission inspection program run by a private contractor, the extremely different weather conditions there cause a different pattern of emission test failure than would occur in Massachusetts. The $5.00 emission inspection fee charged by the private contractor in Arizona is, though, indicative of the charge that would be necessary in Massachusetts.

No state has its emission Inspection and Maintenance program operated by private garages, so comparison is impossible. Even though there are no directly comparable systems in other states, useful data from other programs is available in the appendix which accompanies this report.

3. Loaded Mode vs. Idle Mode

A second major legislative decision involves the choice between an idle-mode and loaded-mode testing procedure. Selection of the idle mode procedure can reduce the total program costs about 25%, according to a California study at Riverside. On the basis of the cost savings, and since the idle test will detect 80% of the failures determined by the more costly and sophisticated loaded-mode procedure, an idle-mode testing program is more cost effective than a loaded-mode program.

Since both test modes are capable of detecting the gross emitters of carbon monoxide and hydrocarbons, the benefits for air quality are very similar. The major advantages to the loaded-mode test, which uses a chassis dynamometer to simulate driving conditions, is its capacity to supply information on nitrogen oxide malfunctions and be used for diagnostic purposes.

Since there are several potential benefits to the loaded-mode test, it may be desirable to choose a program which could later be upgraded to include a chassis dynamometer. Additional tests performed by the California air pollution research facility, however, indicate that the information supplied by

loaded mode testing does not currently contribute to an improved quality of repairs performed by the service industry.

4. Additional Issues

Several additional issues should be addressed in the final program design. Some lend themselves more readily to administrative regulations while others are best handled in the legislation.

- The number of inspection stations

  Increasing the number of stations will increase program costs but decrease waiting times. For example, a Massachusetts' program with 50 facilities and a total of 200 lanes would have a waiting time of between two and five minutes with an average travel distance of five miles.

- Number of annual inspections

  The experience of other states indicates that one inspection per year is sufficient.

- Maximum repair charge

  To avoid excess fees for owners of older vehicles, a maximum repair limit can be established. This would not seriously reduce the air quality improvements if the limit is not set too low. Experience in other states indicates that a $100 limit would be reasonable.

- Number of reinspections

  To avoid situations in which vehicle owners are forced to return repeatedly for reinspection of an automobile that does not pass emission tests after repairs have been made,

provisions can be made for reinspection by the repair industry or a limit can be placed on the maximum number of reinspections.

- Training of repair mechanics

  The Environmental Protection Agency has prepared course material for vocational school programs in Massachusetts and will participate in further educational efforts should the demand arise.

- Repair quality

  It may take some time for the service industry to properly respond to the new requirements of emission control repair. To encourage a rapid transition, a system may be established to allow garages to guarantee their emission control work and/or the state could certify garages with trained mechanics.

- Failure rates

  In order to improve a program's cost effectiveness (both in terms of fuel economy and air improvements), a high failure rate is desirable. A low failure rate will identify the worst polluters but will fail to realize the full program potential.

- Mandatory vs. voluntary repairs

  A mandatory program of repair is eventually required for failed automobiles. However, during the start-up phase, the option exists for a temporary period of mandatory inspection and voluntary repair. It is not possible to say with certainty what effect this would have on public acceptance.

- Vehicle exemptions under the federal regulations

  Vehicles could be excluded from inspection which are heavier than 10,000 pounds, older than 15 years, and which travel slower than 25 mph. Motorcycles may also be excluded.

- Enforcement and penalties

  For vehicle owners and service garages, specific enforcement provisions are needed to insure inspection and to prevent unlawful tampering with emission equipment.